

AMENDMENTS TO THE CLAIMS

1. (Cancelled).
2. (Cancelled).
3. (Cancelled).
4. (Cancelled).

5. (Previously presented) A spot joining device comprising:
a joining tool having a column-shaped shoulder portion at a tip end portion thereof and a pin protruding from an end face of the shoulder portion along an axis thereof;
a frame having a first portion and a second portion fixed to a lower end of the first portion to extend downwardly in a substantially L-shape;
a linear guide provided on the first portion of the frame for guiding the joining tool to be movable upwardly and downwardly along the axis thereof;
a rotation motor for rotating the joining tool around the axis thereof;
a motion motor for moving the joining tool along the axis thereof, and
a column shaped receiving member provided in a tip end portion of the second portion of the frame such that an upper end surface thereof is opposed to the joining tool, and configured to receive lapped works, wherein
the joining tool is moved along the axis by the motion motor while the joining tool is rotated by the rotation motor,
the pin and the shoulder portion are pressed against a predetermined joint spot of the lapped works to be joined and inserted into the predetermined joint spot heated and softened due to friction heat,
portions of the lapped works that are in the vicinity of the predetermined joint spot are stirred by using the rotating pin and shoulder portion, thereby leading to the lapped works being fused at the predetermined joint spot,
the joining tool is then pulled out along the axis by the motion motor,
the joining tool is substantially prevented from moving in a direction crossing an axial direction thereof with respect to the lapped works from the time when the pin and the shoulder portion are pressed against the predetermined joint spot of the lapped works to the time when the joining tool is pulled out, and
whereby the lapped works are spot-joined at the predetermined joint spot.

6. (Previously presented) The spot joining device according to Claim 5, wherein the motion motor is a servo motor.

7. (Previously presented) The spot joining device according to Claim 5, wherein the rotation motor is an induction motor.

8. (Previously presented) The spot joining device according to Claim 5, wherein the rotation motor is a servo motor.

9. (Cancelled).

10. (Cancelled).

11. (Currently amended) [~~The spot joining device according to claim 10~~] A spot joining device comprising:

a joining tool having a column-shaped shoulder portion at a tip end portion thereof and a pin protruding from an end face of the shoulder portion along an axis thereof;

a frame having a first portion and a second portion fixed to a lower end of the first portion to extend downwardly in a substantially L-shape;

a linear guide provided on the first portion of the frame for guiding the joining tool to be movable upwardly and downwardly along the axis thereof; said linear guide comprising a guide rail extending in parallel with the axis of the joining tool, and a guide member moveably attached to the guide rail and rotably supporting the joining tool;

a rotation motor for rotating the joining tool around the axis thereof;

a motion motor provided on the frame for moving the joining tool along the axis thereof, and

a column shaped receiving member provided in a tip end portion of the second portion of the frame such that an upper end surface thereof is opposed to the joining tool, and configured to receive lapped works, wherein a ball screw is mounted on the frame, the ball screw comprising:

a screw shaft mounted on the frame and driven by the motion motor to rotate; and a nut mounted on the guide member and screwed on the screw shaft, and

wherein the joining tool is moved along the axis by the motion motor while the joining tool is rotated by the rotation motor,

the pin and the shoulder portion are pressed against a predetermined joint spot of the lapped works to be joined and inserted into the predetermined joint spot heated and softened due to friction heat,

portions of the lapped works that are in the vicinity of the predetermined joint spot are stirred by using the rotating pin and shoulder portion, thereby leading to the lapped works being fused at the predetermined joint spot,

the joining tool is then pulled out along the axis by the motion motor,

the joining tool is substantially prevented from moving in a direction crossing an axial direction thereof with respect to the lapped works from the time when the pin and the shoulder portion are pressed against the predetermined joint spot of the lapped works to the time when the joining tool is pulled out, and

whereby the lapped works are spot-joined at the predetermined joint spot.

12. (Previously presented) The spot joining device according to Claim 5, wherein the rotation motor is provided on the guide member.

13. (Cancelled).

14. (Previously presented) The spot joining device according to Claim 5, wherein the receiving member is disposed coaxially with the joining tool.

15. (Cancelled).

16. (Previously presented) The spot joining device according to Claim 5, wherein the spot joining device is a spot gun worn on a wrist of an articulated robot.

17. (Previously presented) The spot joining device according to Claim 5, wherein the spot joining device is a spot gun which is movably carried by an operator to perform spot joining operation therewith.

18. (Previously presented) A spot joining method comprising the steps of:
preparing a joining tool having a column-shaped shoulder portion at a tip end portion thereof and a pin protruding from an end face of the shoulder portion along an axis thereof, a frame having a first portion and a second portion fixed to a lower end of the first portion to extend downwardly in a substantially L-shape, a linear guide provided on the first portion of the frame for guiding the joining tool to be movable upwardly and downwardly along the axis thereof, a rotational motor for rotating the joining tool around the axis thereof, a motion motor for moving the joining tool along the axis thereof, and a column-shaped receiving member provided in a tip end portion of the second portion of the frame such that an upper end surface thereof is opposed to the joining tool, and configured to receive lapped works;

rotating the joining tool and pressing the shoulder portion against a predetermined joint spot of lapped works to be joined;

inserting the pin and the shoulder portion into the predetermined joint spot of the lapped works heated and softened due to friction heat;

stirring portions of the lapped works that are in the vicinity of the predetermined joint spot by using the rotating pin and shoulder portion, thereby leading to the lapped works being fused at the predetermined joint spot,

pulling out the joining tool along the axis, and

substantially preventing the joining tool from moving in a direction crossing an axial direction thereof with respect to the lapped works from the time when the pin and the shoulder portion are pressed against the predetermined joint spot of the lapped works to the time when the joining tool is pulled out, thereby performing spot joining of the lapped works at the predetermined joint spot.

19. (Previously presented) The spot joining method according to Claim 18, wherein a receiving member is disposed opposite to a tip end portion of the joining tool, the receiving member having a flat receiving face on which the lapped works to be joined are placed and receiving a pressing force from the joining tool pushing against the lapped works.

20. (Previously presented) A spot joining method for spot-joining lapped works by using the spot joining device according to in Claim 5.

21. (Previously presented) The spot joining method according to Claim 18, wherein the lapped works are comprised of two or more works.

22. (Previously presented) The spot joining method according to Claim 18, wherein the lapped works are a plurality of flat-plate shaped or three-dimensionally shaped works having lapped faces to be spot-joined.

23. (Previously presented) The spot joining method according to Claim 18, wherein the lapped works are works made of metal, works made of synthetic resin, or works in which decorative sheets made of synthetic resin are bonded to outer faces of metal plates.

24. (Previously presented) The spot joining method according to Claim 18, wherein the lapped works are outer plates of an automobile.

25. (Previously presented) The spot joining method according to Claim 18, wherein the lapped works are outer plates of a railway vehicle.

26. (Previously presented) A method of manufacturing an outer plate of an automobile by a method for spot-joining lapped works and forming a concave portion at a joint spot of the lapped works, the method comprising the steps of:

rotating a joining tool having a column-shaped shoulder portion at a tip end portion thereof and a pin protruding from an end face of the shoulder portion along an axis thereof with the pin and the shoulder portion pressed against a predetermined joint spot of lapped works to be joined which constitute an outer plate of an automobile,

inserting the pin and the shoulder portion into the predetermined joint spot of the lapped works heated and softened due to friction heat,

stirring portions of the lapped works that are in the vicinity of the predetermined joint spot by using the rotating pin and shoulder portion, thereby leading to the lapped works being fused at the predetermined joint spot while forming a concave portion of the joint spot of the lapped works on which the spot-joining was performed so as to substantially conform in shape to an outer shape of the pin and the shoulder portion of the joining tool,

pulling out the joining tool along the axis, and

substantially preventing the joining tool from moving in a direction crossing an axial direction thereof with respect to the lapped works from the time when the pin and the shoulder portion are pressed against the predetermined joint spot of the lapped works to the time when the joining tool is pulled out,

thereby performing spot-joining of the lapped works at the predetermined joint spot.

27. (Cancelled).

28. (Cancelled).

29. (Cancelled).

30. (Cancelled).

31. (Cancelled).

32. (Cancelled).

33. (Cancelled).

34. (Cancelled).

35. (Cancelled).

36. (Cancelled).

37. (Cancelled).

38. (Previously presented) The spot joining device according to claim 5, wherein a concave portion is formed at the joint spot of the lapped works on which the spot-joining was performed so as to conform in shape to the pin and the shoulder portion of the joining tool.

39. (Previously presented) The spot joining method according to claim 18, wherein a concave portion is formed at the joint spot of the lapped works on which the spot-joining was performed so as to conform in shape to the pin and the shoulder portion of the joining tool.

40. (Cancelled).

41. (Previously presented) An outer plate of an automobile containing a concave portion, manufactured in accordance with the method of claim 26.